

Evaluating the Conservatism of Deterministic Ground Motions using Probabilistic Seismic Hazard Analysis

Association of Engineering Geologists

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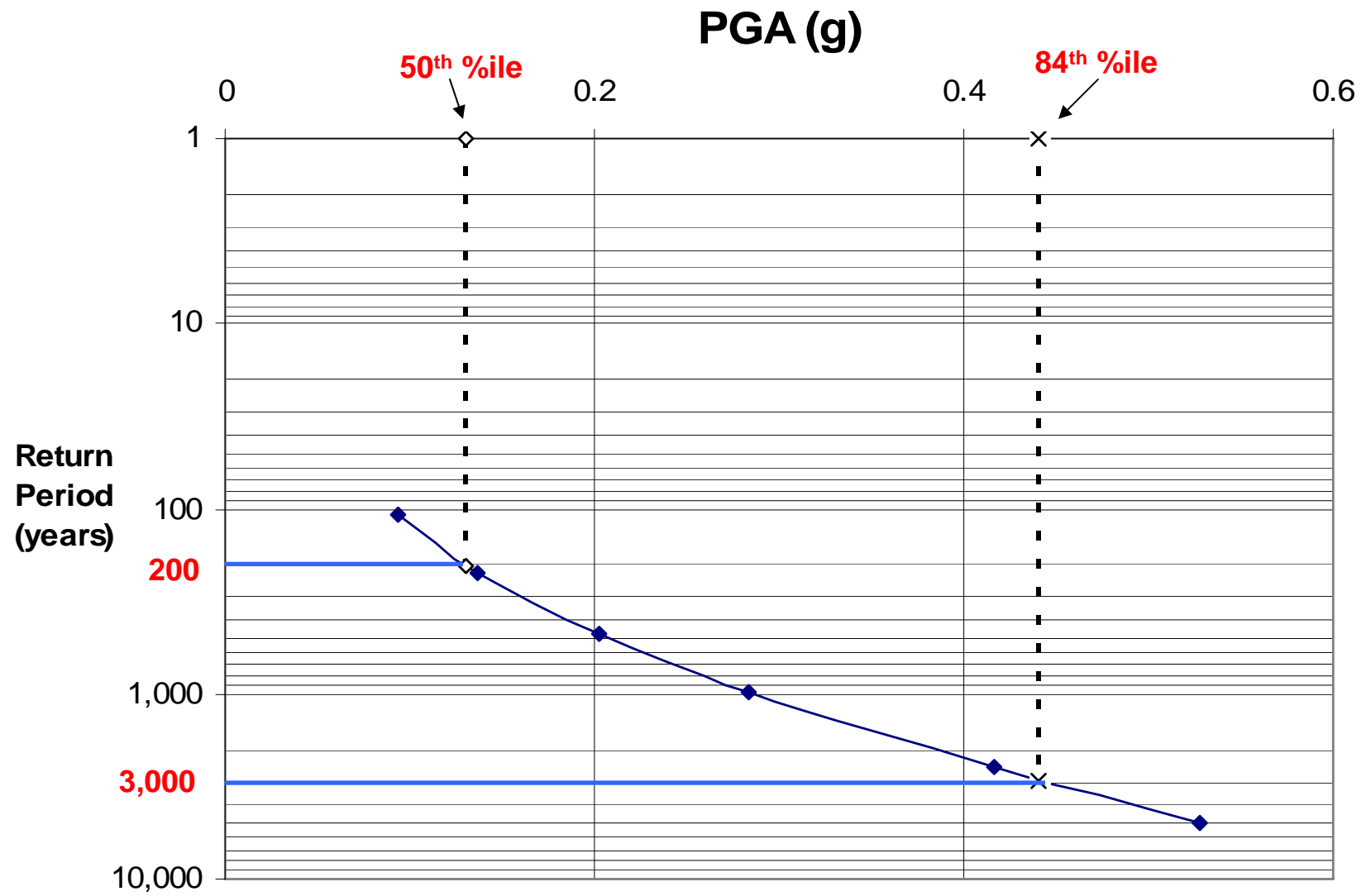
and

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California Division of Safety of Dams

DSHA and PSHA used together

- ◆ New procedures developed in 2002
<http://damsafety.water.ca.gov>
- ◆ Appropriate deterministic “level of design” is selected by matrix which considers:
 - the likelihood of earthquake
 - consequence of dam failure
- ◆ *An evaluation of the return period associated with the 50th and 84th percentiles deterministic estimates is used to evaluate DSHA conservatism*



Purpose of This Study

- ◆ The 2002 Consequence-Hazard matrix was originally calibrated using about 30 comparisons between deterministic and probabilistic PGA determinations.
- ◆ The data set now includes over 100 deterministic and probabilistic PGA comparisons. These ground motions were developed for:
 - ◆ Proposed dam analyses
 - ◆ Reanalysis of existing dams in high slip rate fault corridors
 - ◆ Radial gate analyses
- ◆ These comparisons are used to confirm matrix calibration and to identify typical conservatism in three regions of California with many dams.

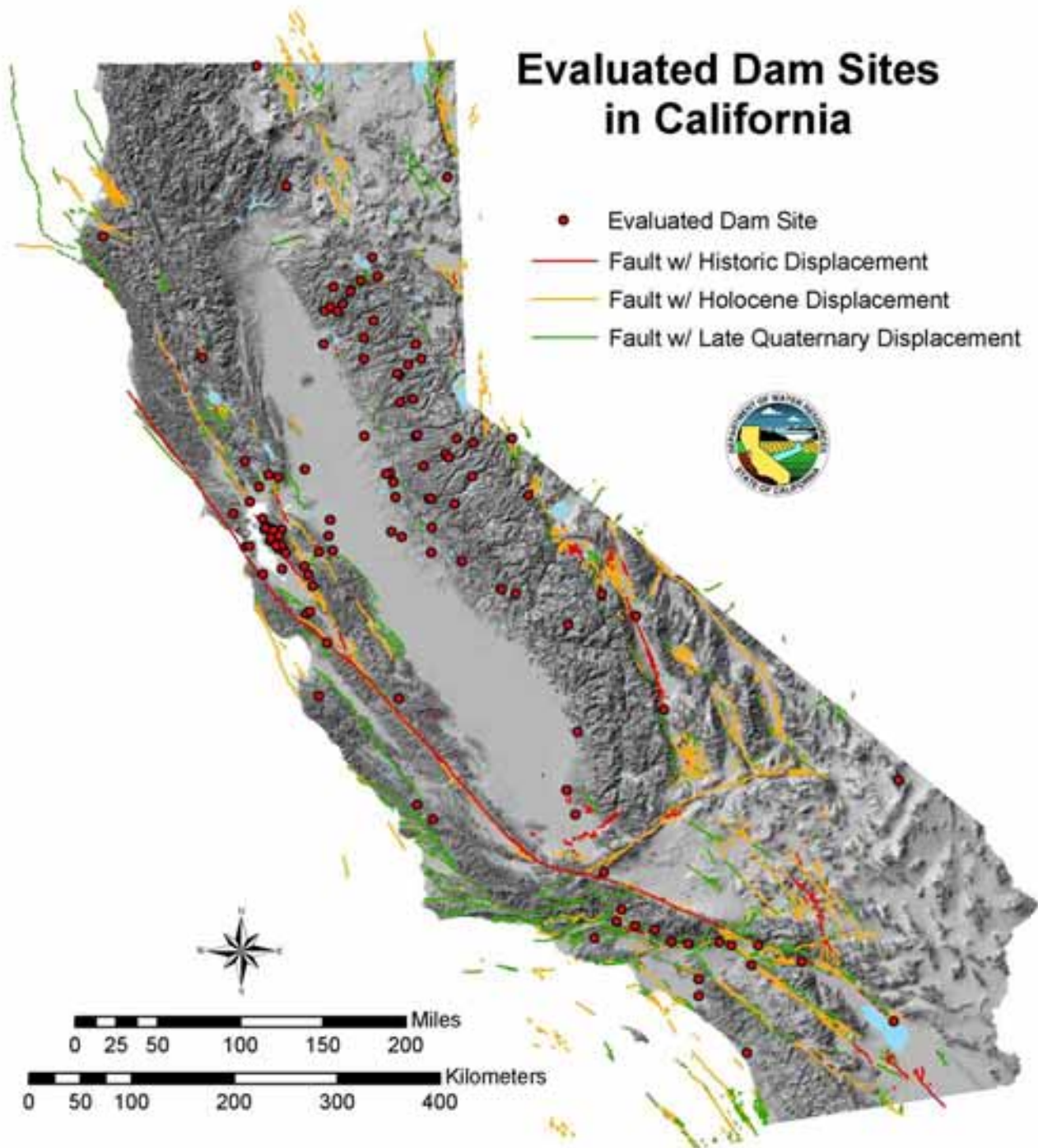
DSOD Deterministic Practice

- ◆ Peak Acceleration and Spectral Accelerations
 - Abrahamson and Silva, 1997
 - Sadigh et al., 1997
 - Boore et al., 1997
- ◆ Modifications for Directivity
 - Abrahamson, 2000
 - Somerville et al. 1997

DSOD Probabilistic Practice

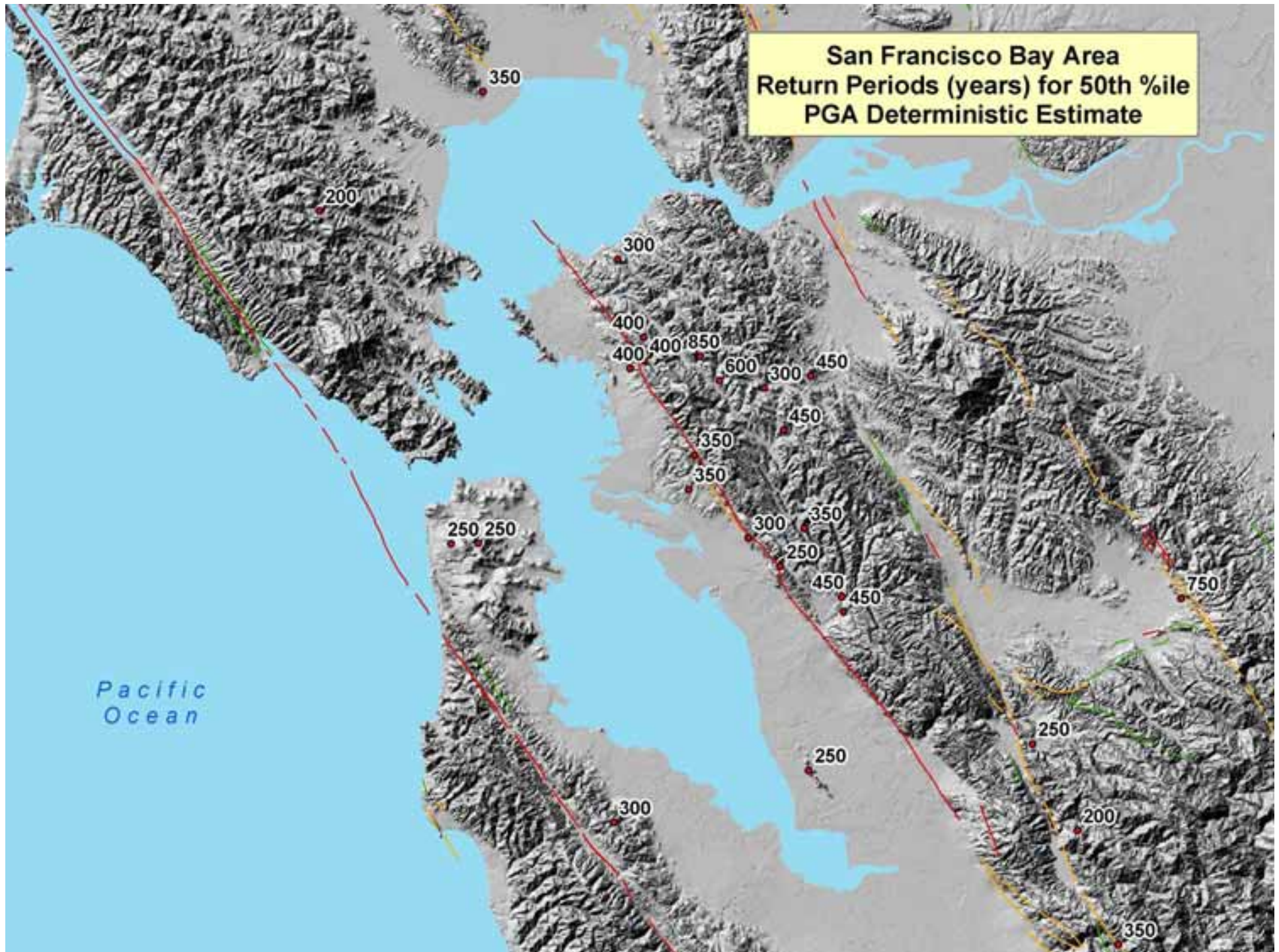
- ◆ USGS Interactive Deaggregation Website
 - Uses “consensus” fault models
 - Low start-up costs
 - Provides only approximate return periods
 - Appropriate for assessing conservatism

Evaluated Dam Sites in California

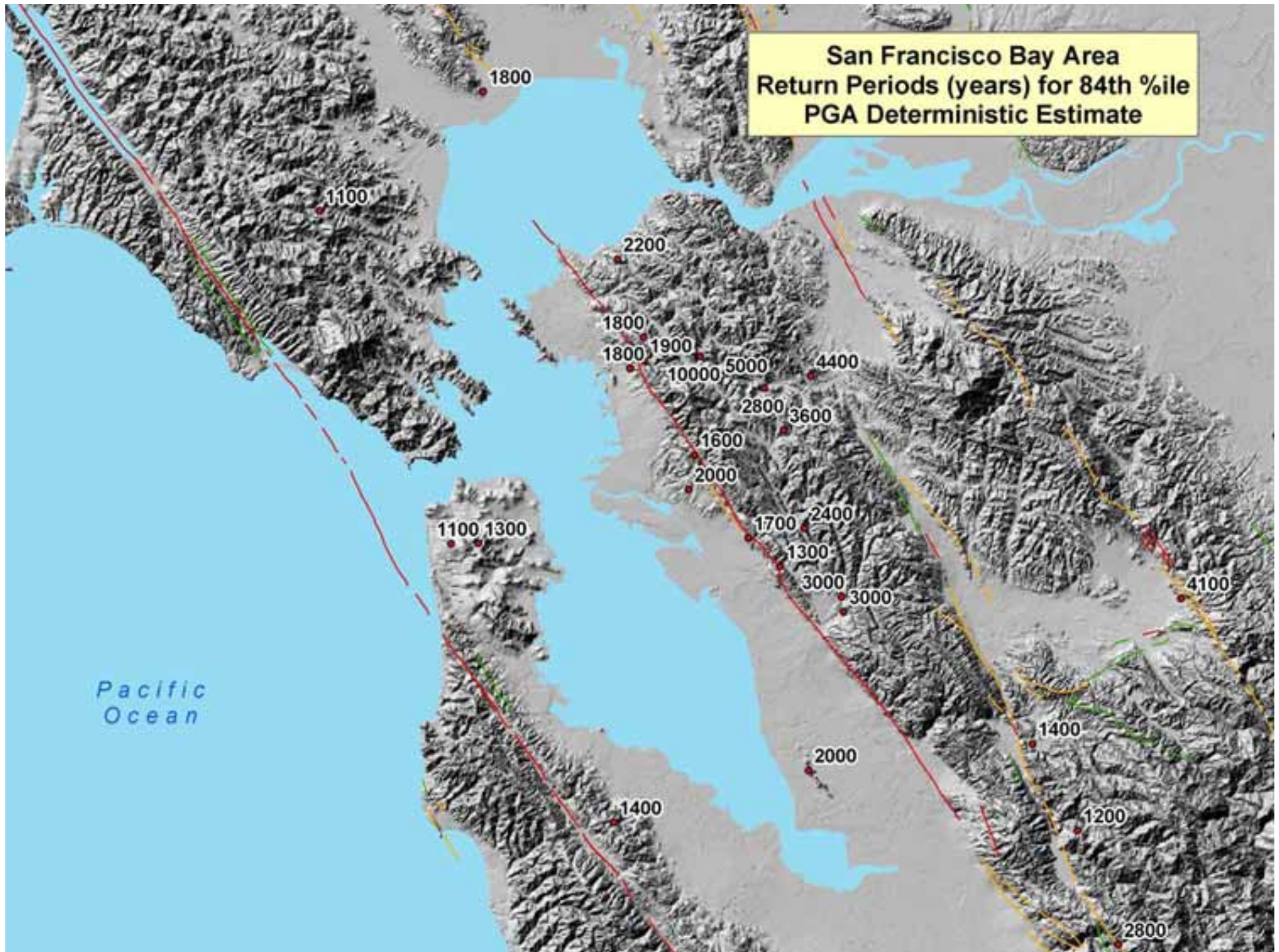


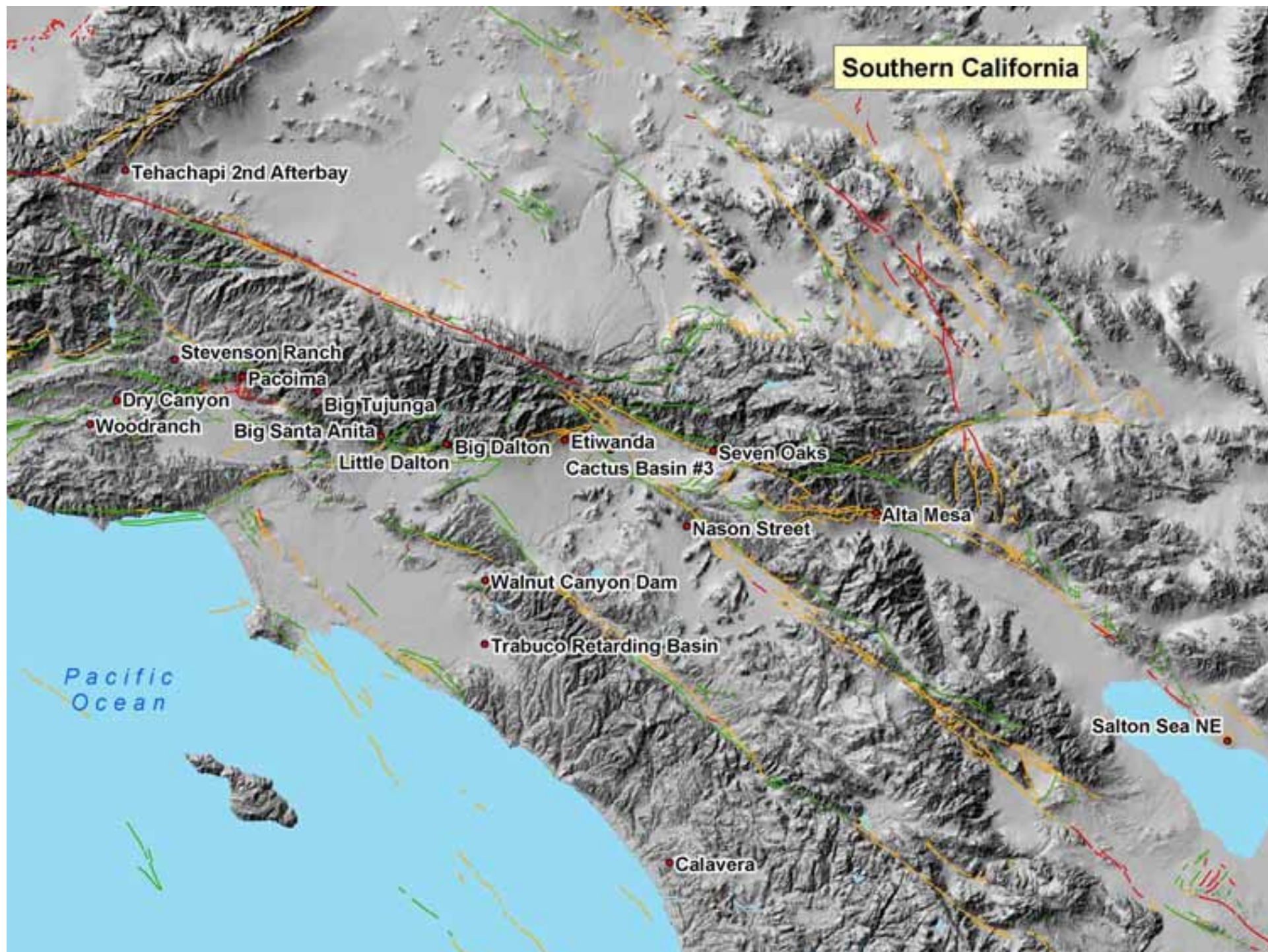


San Francisco Bay Area
Return Periods (years) for 50th %ile
PGA Deterministic Estimate

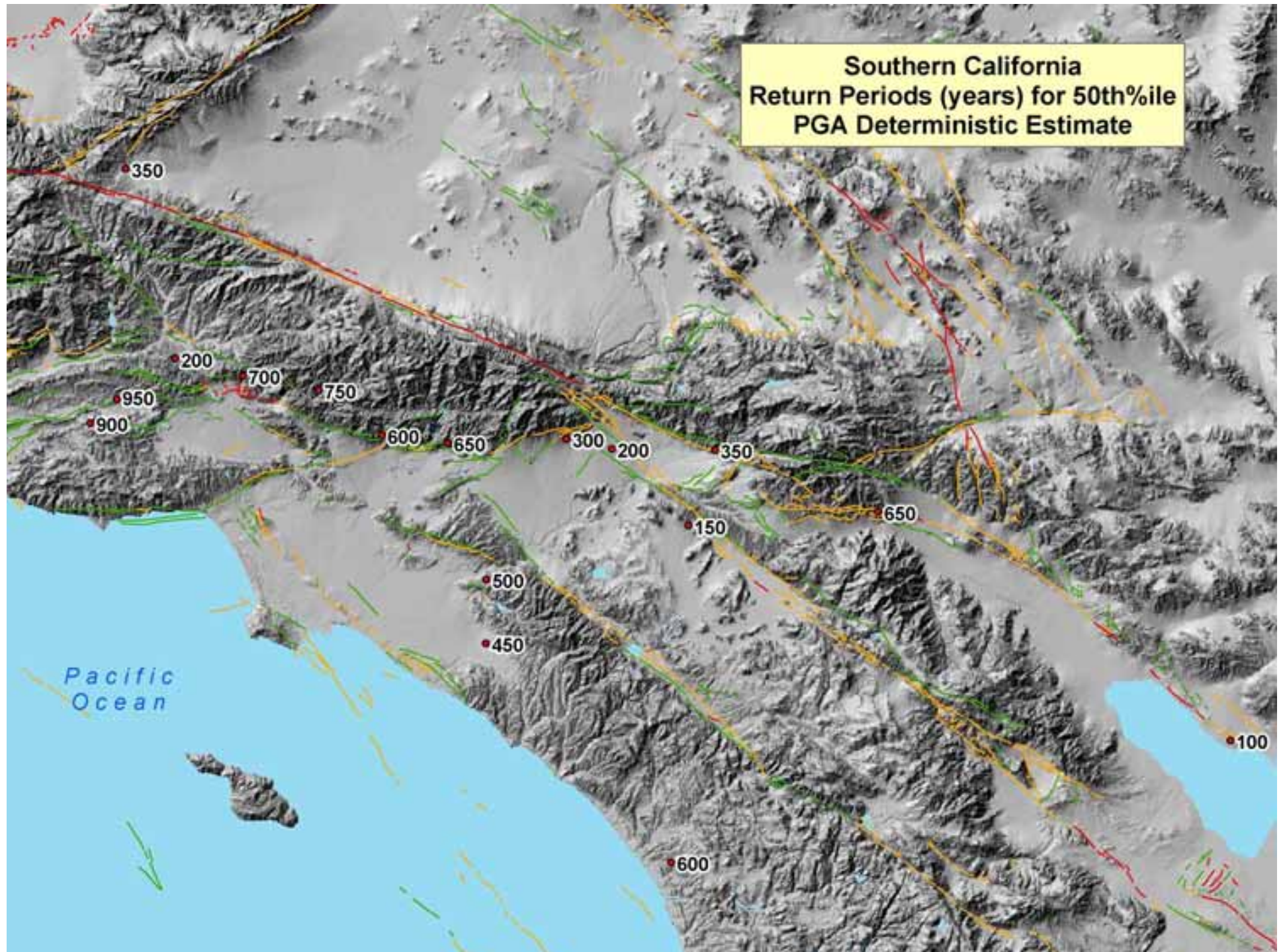


**San Francisco Bay Area
Return Periods (years) for 84th %ile
PGA Deterministic Estimate**

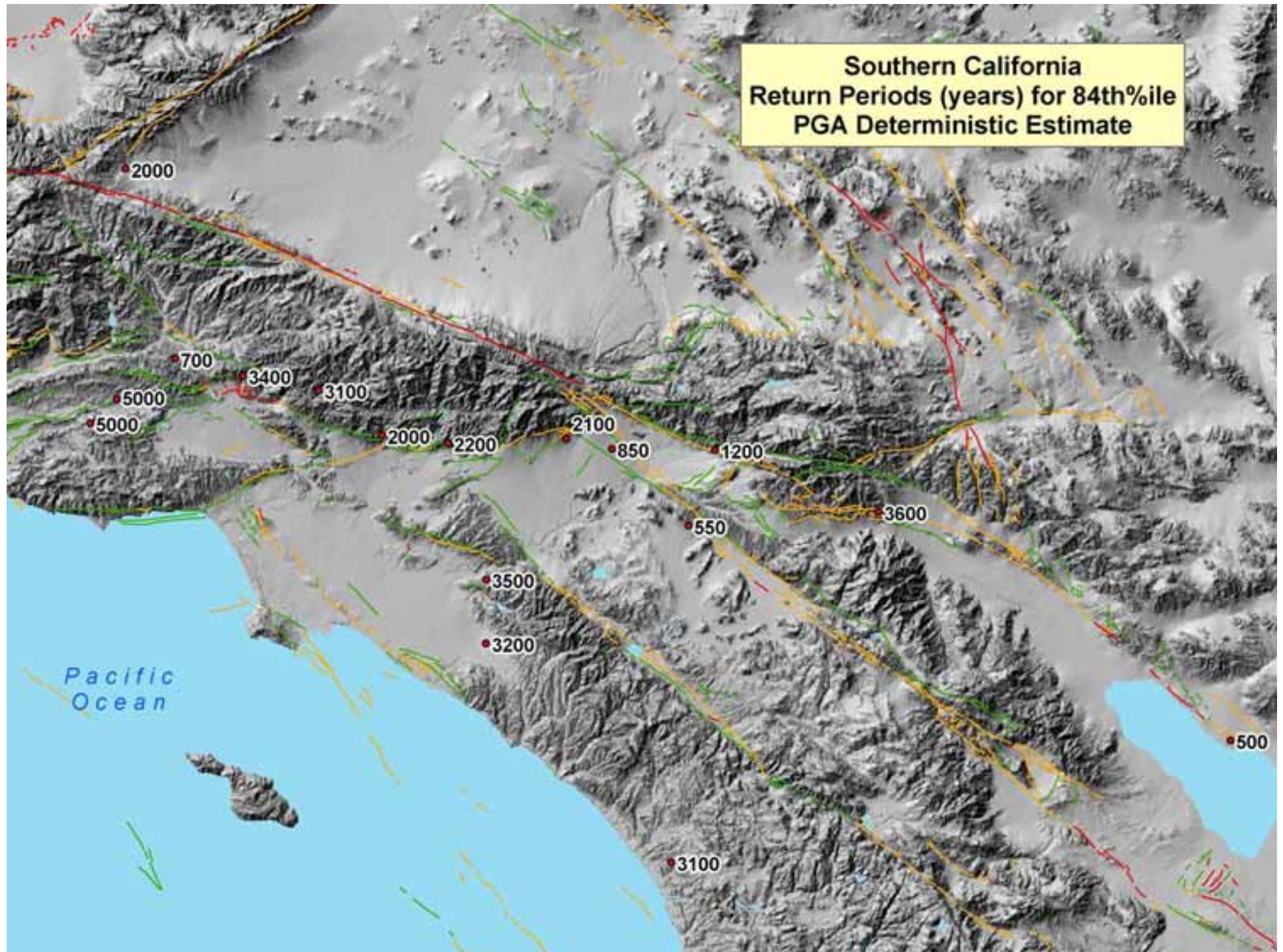


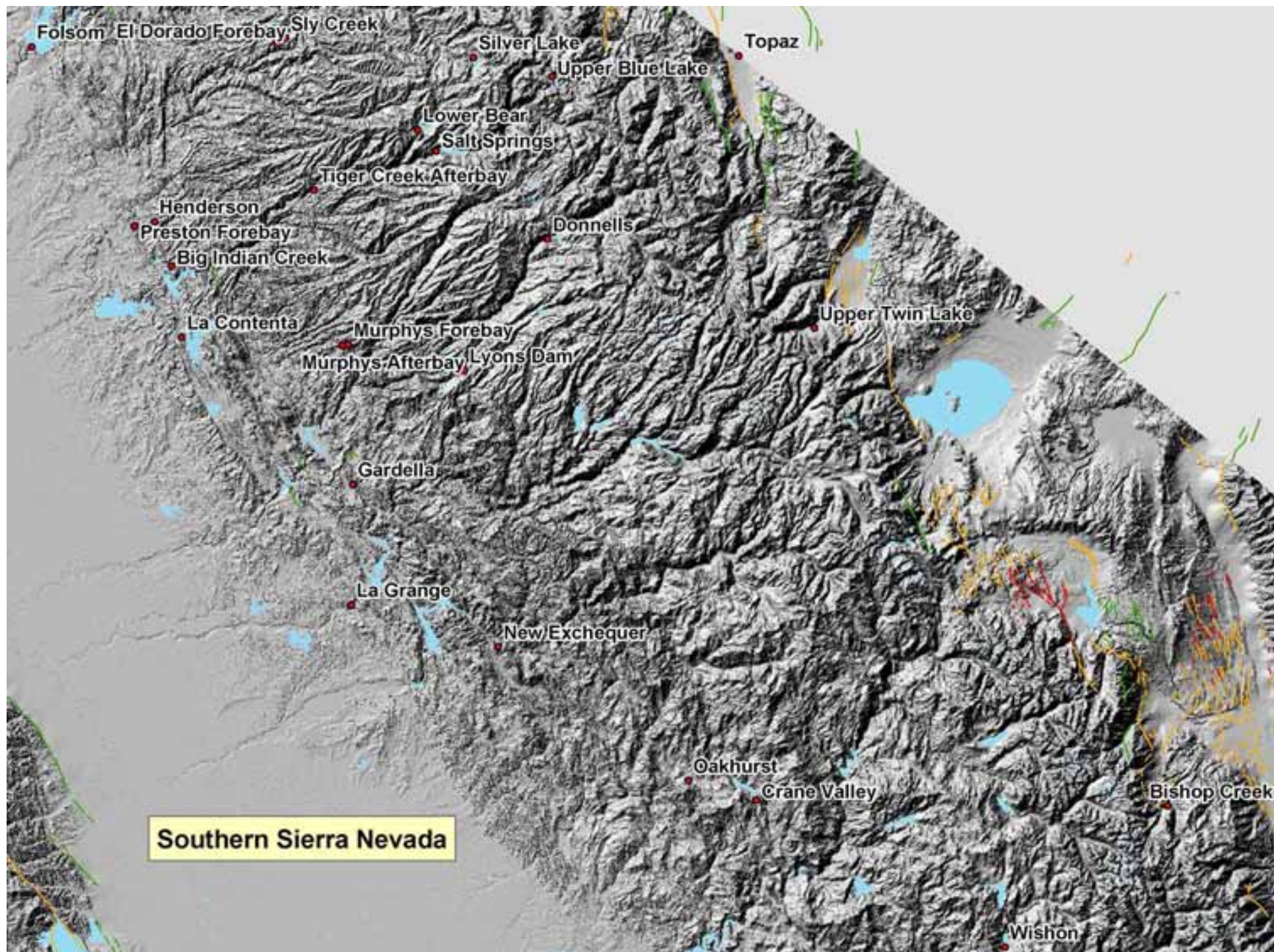


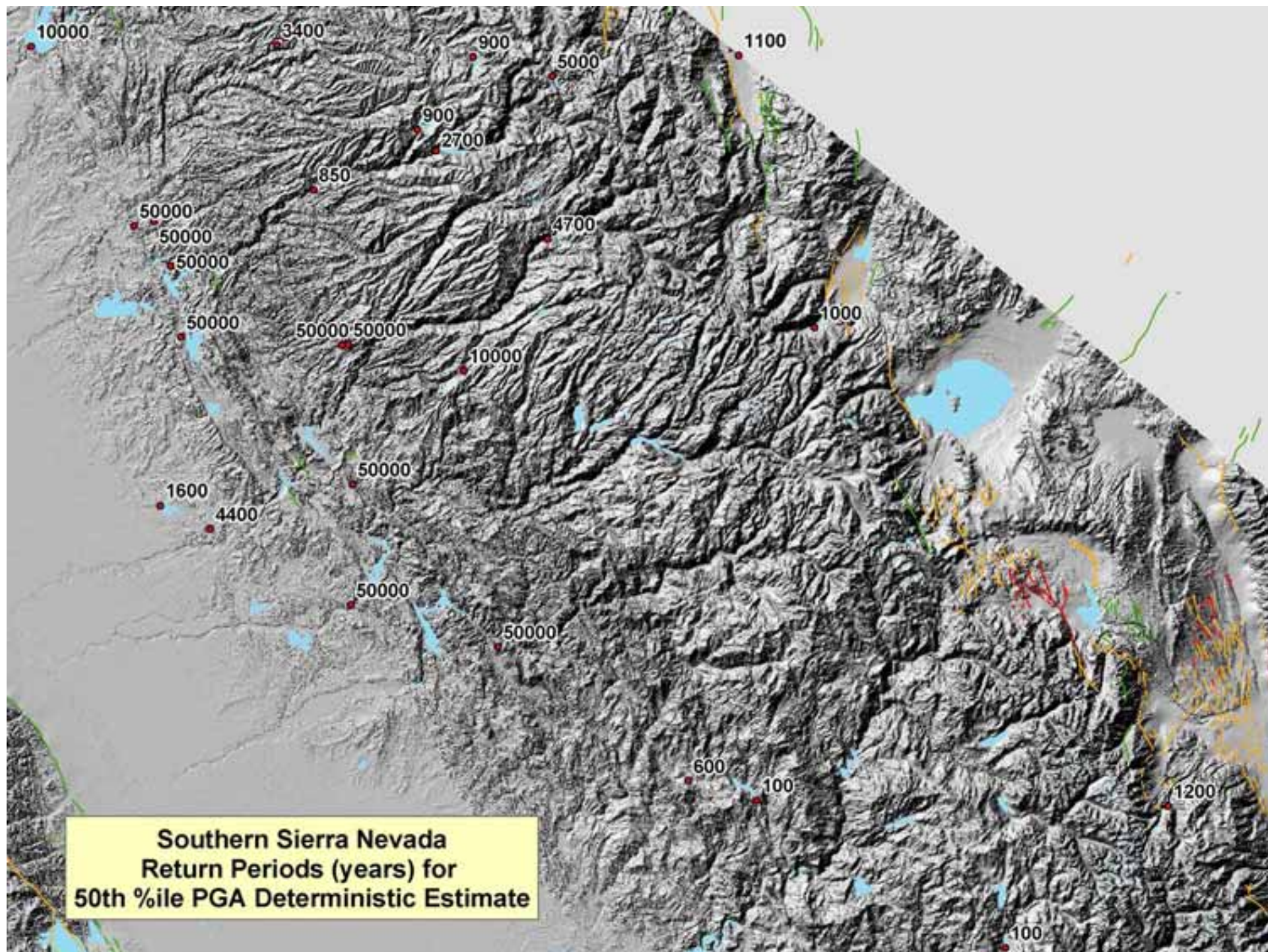
**Southern California
Return Periods (years) for 50th%ile
PGA Deterministic Estimate**

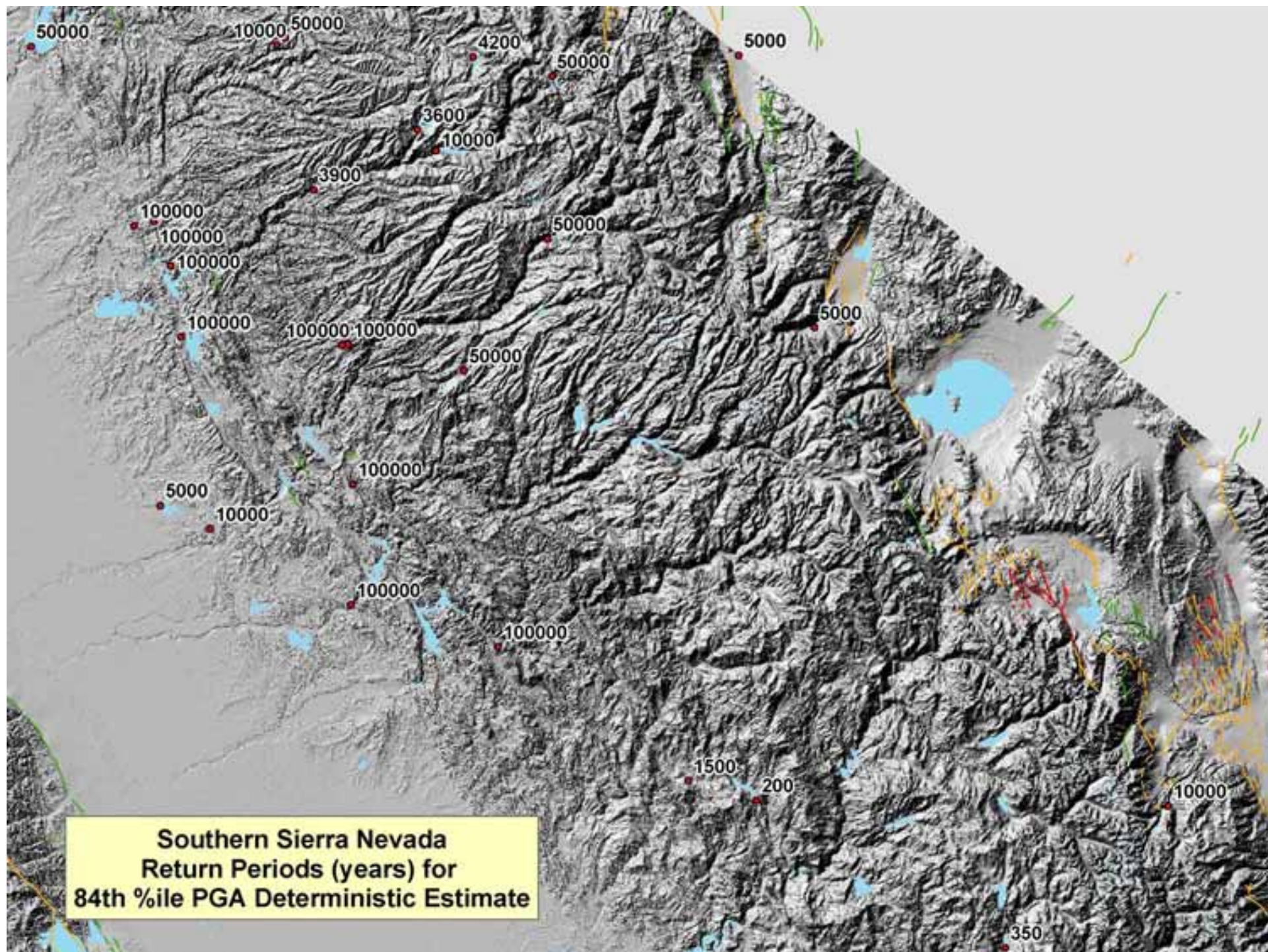


**Southern California
Return Periods (years) for 84th%ile
PGA Deterministic Estimate**










Conclusions

- ◆ Evaluation of the return period associated with deterministic ground motion estimates provides insight into their conservatism

Conclusions

- ◆ The conservatism of a deterministic ground motion depends on:
 - The statistical level of deterministic design chosen
 - The region of California

Factors influencing the conservatism of deterministic ground motions

- ◆ Slip rate of the fault
 - ◆ Complexity of faulting (the number of faults affecting a site and their geometry)
 - ◆ DSHA and PSHA “modeling” issues
 - Low slip rate conditionally active faults
 - The unrecognized seismic source
 - Event recurrence assumptions
- 
- A stylized teal silhouette of a mountain range is located in the bottom right corner of the slide, partially overlapping the text area.

Deterministic Dam Design

- ◆ San Francisco Bay Area:
 - 84th percentile provides a 1000 to 4000 year return period.
 - Higher for conditionally active faults
- ◆ Los Angeles Area:
 - 84th percentile provides a 500 to 5000 year return period

Deterministic Dam Design

- ◆ Eastern Sierra:

- 84th percentile motions provides 5,000 to 10,000 year return periods

- ◆ Sierra Foothills:

- 84th percentile motions provides 10,000 to 100,000 year return periods

- ◆ Southern Sierra:

- 84th percentile motions provides as low as a 200 year return period
 - ◆ indicating need for a “floating earthquake” scenario or minimum earthquake loading parameters